Wildlife Services

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National Wildlife Research Center

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Ecology, Control, and Prevention of Terrestrial Rabies in Free-Ranging Wildlife

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Major Cooperators

- Kansas State University
- Centers for Disease Control and Prevention
- New Mexico State University
- FoodSource (private bait company)
- MERIAL, Inc. (private vaccine development company)
- Purdue University
- Texas A&M University
- Texas State Department of Health Services
- USDA/APHIS/Wildlife Services Operations
- Cleveland Metroparks

Groups Affected By These Problems

- U.S. citizens
- Wildlife and natural resource managers
- Veterinarians
- Livestock producers and farmers
- Sporting organizations
- Consumers

National Wildlife Research Center Scientists Develop New Methods, Strategies to Reduce Rabies Transmission from Infected Wildlife to Humans, Domestic Animals, and Wildlife

Wildlife Services' (WS) National Wildlife Research Center (NWRC) is the only Federal research organization devoted exclusively to resolving conflicts between people and wildlife through the development of effective, selective, and socially responsible methods, tools, and techniques.

Increased urbanization, greater acceptance of and desire for living closer to free-ranging wildlife, and burgeoning wildlife numbers have led to increased conflict between people and wildlife. Such conflict can take many forms, including the transmission of diseases among wildlife, livestock, and humans. Indeed, many of the pathogens that cause animal disease also are capable of causing disease in humans. Appropriately, there is a great need to understand the processes mediating disease transmission between wildlife, livestock, and humans.

Rabies is an acute, fatal viral disease, most often transmitted through the bite of a rabid mammal, which can infect people as well as animals. Impacts to society from this and other wildlife diseases can be great. For instance, the cost of detection, prevention, and control of rabies in the United States is exceeding $300 million annually.

In 2000, the Secretary of Agriculture enacted a Declaration of Emergency for rabies, citing threats to livestock and to public health and safety. In 2001, NWRC initiated research to help reduce the transmission of this disease.

In the United States, terrestrial rabies can be found in many wild animals, including raccoons, skunks, gray foxes, arctic foxes, bobcats, and coyotes. In an effort to halt the spread and, eventually, eliminate terrestrial rabies in the United States, NWRC scientists are researching the behavior, ecology, movement, and population structure of raccoons and other wildlife hosts. They also are evaluating methods and techniques used to vaccinate wildlife against rabies to decrease the risk of transmission and maintenance of the disease in the wild.

Applying Science & Expertise to Wildlife Challenges

Coyotes and Bobcats as Potential Vectors of the Gray Fox Rabies Variant— Although all mammals are susceptible to rabies, only a few species are important reservoirs and/or vectors of the disease. The Texas gray fox variant of rabies is a strain adapted to and maintained by gray foxes in Texas since 1946. In 2007, the Texas fox-variant was detected in gray foxes, coyotes, and bobcats in west Texas, sparking concern that the variant may also be propagated through contact between the latter two species. If true, the ability of coyotes and bobcats to transmit fox-variant rabies will represent new health risks to humans, companion animals, and livestock. NWRC scientists and collaborators have determined that bobcats infected with rabies accumulate enough of the virus to potentially infect other animals through a bite. In addition, a field study in west Texas has identified habitat types that facilitate interaction, and possible rabies transmission between the three species. This information will be vital for informing bait distribution operations conducted by the WS and the Department of Health Services to control rabies in Texas.

Screening Rabid Animals with Infrared Thermography— NWRC researchers are investigating the use of infrared thermography (IRT) as a field tool to non-invasively detect rabies in raccoons captured during trap-vaccinate-release (TVR) efforts. NWRC and WS personnel evaluated IRT on 311 animals captured during TVR efforts in Ohio. The ability of IRT to correctly identify rabies-negative raccoons ranged from 85 to 98 percent, depending upon the operator. Thirty-two of the trapped animals showed possible signs of being rabid, but were later determined to be negative for rabies. Researchers are now preparing to test IRT in areas of higher rabies prevalence, and under varying environ-

mental conditions to identify factors that may influence the occurrence of false positive and negative results.

Raccoon Movements and Dispersal in Urban Enviroments— In 2004, raccoon variant rabies moved westward from Pennsylvania into eastern Ohio. In an effort to prevent further spread across Ohio, WS expanded the oral rabies vaccination (ORV) boundary west toward Cleveland. NWRC researchers conducted a study to better understand how raccoon-vectored rabies might move through urban areas of Cleveland and to help develop a vaccination strategy to stop this spread. Researchers found that radio-collared raccoons restricted their space use to small green spaces when available, but also occasionally inhabited abandoned houses. Restricted movements by raccoons in urban areas suggest that rabies may spread more slowly in these locations than in surrounding areas with higher levels of habitat connectivity. However, this finding does not suggest that urban areas should be disregarded when conducting ORV baiting operations. Small, tree-covered habitat patches-particularly those that border urban housing areas—should be hand-baited in an effort to prevent rabies spread within and between raccoons, domestic animals and humans.

Using Contraceptives to Curtail the Spread of Rabies— NWRC researchers are evaluating the use of the Gonacon™ vaccine, an immunocontraceptive, as a tool for the National Oral Rabies Vaccination (ORV) Program. The GonaCon™ vaccine stimulates the production of antibodies that bind to gonadotropin-releasing-hormone (GnRH), which signals the production of sex hormones. The antibodies reduce GnRH's ability to stimulate the release of sex hormones, and inhibit sexual activity and reproduction within individuals for up to two years**.** Researchers have treated raccoons with Gonacon™, the rabies vaccine, and a combination of the two vaccines to simulate trap vaccinate release (TVR) procedures used by the ORV Program to control rabies outbreaks. Results suggest that the Gonacon™ vaccine inhibits reproduction in raccoons for at least one breeding season and does not compromise the integrity of the rabies vaccine. Gonacon™, in concert with the rabies vaccine, may help control the spread of rabies through reducing the size of raccoon populations while increasing vaccination coverage.

Improving Rabies Vaccine Uptake in Wildlife— Devising ways to increase rabies vaccinate rates is a primary goal for the rabies research team at NWRC. Researchers are working with Merial, Ltd. (Athens, Georgia), to investigate ways to improve RABORAL V-RG through the addition of adjuvants and thickeners. Raccoons, gray foxes, coyotes, and possibly other terrestrial mammals are vaccinated by ingesting the liquid vaccine which is held in a plastic sachet and surrounded by a palatable bait. Because the vaccine is in a liquid state, it is vulnerable to spillage following puncture of the sachet. Spillage, in turn, results in an animal receiving a lower than desired dose of the vaccine, which often necessitates the need for an animal to consume multiple vaccine baits to become immunized. To address this problem, researchers are evaluating the efficacy of using natural additives to increase the viscosity of the liquid vaccine and to act as adjuvants to enhance the immune response. This work will improve the effectiveness of the oral rabies vaccine, decrease the need for an animal to consume multiple vaccine baits, and potentially result in cost-savings to the ORV program.

Selected Publications:

FRY, T. L., T. C. ATWOOD, AND M. R. DUNBAR. 2010. Evaluation of rhodamine B as a biomarker for raccoons. Human-Wildlife Interactions 4:275-282.

DEYOUNG, R. W., A. ZAMORANO, B. T. MESENBRINK, T. A. CAMPBELL, B. R. LELAND, G. M. MOORE, R. L. HONEYCUTT, AND J. J. ROOT. 2009. Landscape-genetic analysis of population structure in the Texas gray fox oral rabies vaccination zone. Journal of Wildlife Management 73:1292-1299.

JOHNSON, S. R., A. J. PIAGGIO, M. A. NEUBAUM, AND M. R. DUNBAR. 2009. Using genetics to assess differentiation among raccoons in an area with variable rabies status in Alabama. Proceedings of the Wildlife Damage Management Conference 13:40-48.

PUSKAS, R. B., J. W. FISCHER, C. B. SWOPE, M. R. DUNBAR, R. G. MCLEAN, AND J. J. ROOT. 2010. Raccoon (*Procyon lotor*) movements and dispersal associated with ridges and valleys of Pennsylvania: implications for rabies management. Vector-Borne and Zoonotic Diseases 10.

ROOT, J. J., R. B. PUSKAS, J. W. FISCHER, C. B. SWOPE, M. A. NEUBAUM, S. A. REEDER, AND A. J. PIAGGIO. 2009. Landscape genetics of raccoons (Procyon lotor) associated with ridges and valleys of Pennsylvania: implications for oral rabies vaccination programs. Vector-borne and Zoonotic Diseases 9:583-588.

Major Research Accomplishments:

- WS studies on the gray fox variant of rabies in bobcats revealed that sufficient amounts of the virus are present in infected animals to cause infection in other mammals if bitten by bobcats. However, because only mild clinical signs of aggressive behavior were observed in bobcats, more research is needed to determine whether bobcats infected with the gray fox variant of rabies can develop sufficient aggression to bite others and transmit the virus.
- WS studies tested the use of infrared thermography as a field tool to detect rabies in trapped raccoons.
- WS field studies showed restricted movements by raccoons in urban areas suggesting that rabies may spread more slowly in these locations than in surrounding areas with higher levels of habitat connectivity.
- WS used a method called vitrification to help WS' ORV program increase rabies vaccination rates for wild, free-ranging wildlife. Vitrification of the Raboral V-RG® vaccine provides protection from a loss of viability at elevated temperatures. Results suggest that the vaccine virus would remain stable for longer periods of time in a vitrified format.